

Earthworms (Annelida, Oligochaeta) from the Imperial Palace, Tokyo

By

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石塚小太郎¹⁾・宍倉文夫²⁾・今島 実³⁾：皇居の貧毛類

Introduction

The Imperial Palace of Japan is located at the central part of urban Tokyo, occupying about 1.15 million square meters. Surveys of flora and fauna in the Imperial Palace were carried out by the National Science Museum, Tokyo during the periods from 1996 to 1999. We were given a chance to study earthworms in this project. Our survey resulted in an earthworm collecting being composed of 583 specimens from 22 stations in the grounds of the Imperial Palace (Fig. 1). Seventeen species, including four new species of the genus *Pheretima*, and three indeterminable species were recognized in total and assigned to four genera in three families (Megascolecidae, Lumbricidae and Moniligastridae).

We would like to express our cordial thanks to the staff members of the Garden Division, Management Department, Imperial Household Agency, for their cooperation in undertaking the present survey.

The bulk of the collection, including type specimens, has been deposited in the National Science Museum, Tokyo.

Family Megascolecidae Rosa, 1891

Genus *Pheretima* Kinberg, 1867

1. *Pheretima agrestis* (Goto & Hatai, 1899)

[Japanese name: Hatake-mimizu]

Perichaeta agrestis Goto & Hatai, 1899, p. 17, fig. 7 ; Yamaguchi, 1930, p. 51, fig. 3.

Pheretima agrestis: Michaelsen, 1900, p. 313 ; Yamaguchi, 1962a, p. 25, fig. 10.

Amyntas agrestis: Beddard, 1900, p. 637.

Materials examined. Sts. 4 (12 specimens), 14(1), 15(4).

External characters. Length of body 90–180 mm, width 5.0–7.0 mm, with 80–110 segments. Brown

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dorsally. Three pairs of spermathecal pores situated in furrows 6/7/8. Genital markings absent. External markings of brown colored patch present ventrally on segments VI–VIII. Male pores simple, superficial on segment XVIII, but rarely found. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13 or 11/12. Clitellum including segments XIV–XVI.

Internal characters. Maniccate intestinal caeca each with 7–9 diverticula, originating in segment XXVII. Genital glands absent. Three pairs of spermathecae on segments VIII–IX; ampulla consisting of shovel-shaped pouch and duct; diverticulum consisting of sausage-shaped pouch and duct.

Distribution. Japan (Kyushu, Shikoku, Honshu, Hokkaido), Korea.

2. *Pheretima aokii* Ishizuka, 1999

[Japanese name: Aoki-mimizu]

Pheretima aokii Ishizuka, 1999a, pp. 36–38, figs. 9–18.

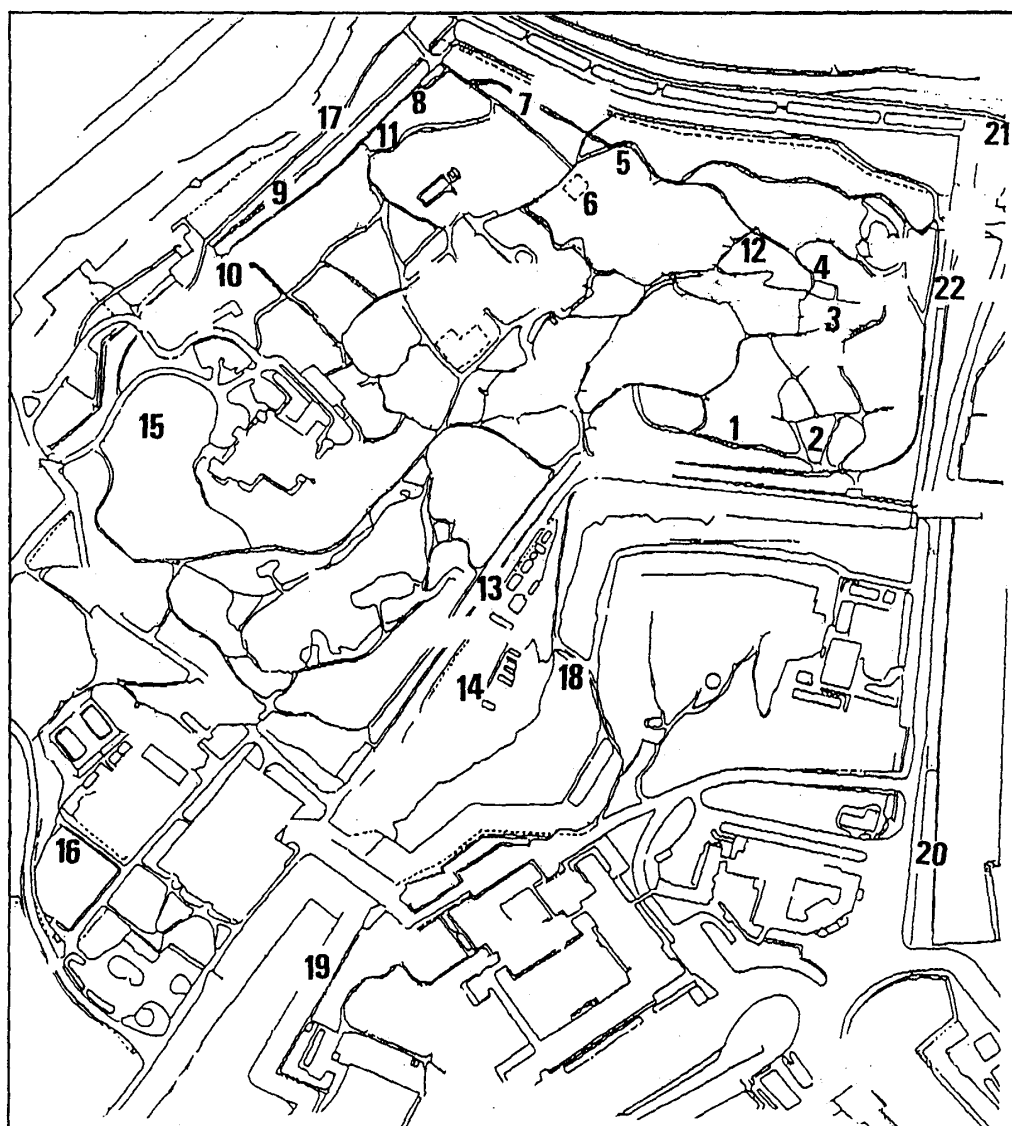


Fig. 1. Map of the Imperial Palace, showing the collecting stations.

Materials examined. Sts. 3(3), 4(11), 5(2), 7(1), 10(1), 11(1), 12(7), 15(3), 16(6).

External characters. Length of body 60–125 mm, width 3.5–6.5 mm, with 70–105 segments. Reddish brown dorsally. Two pairs of spermathecal pores situated in furrows 6/7/8. Genital markings in two large clusters, each consisting of several to a dozen pieces of genital papillae on segment XVIII. Male pores absent. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI.

Internal characters. Maniccate intestinal caeca each with 5–6 diverticula, originating in segment XXVII. Genital glands consisting of capsulogenous glands. Two pairs of spermathecae in segments VII–VIII; ampulla consisting of shovel-shaped pouch and duct, frequently poorly developed or lacking; diverticulum absent.

Distribution. Japan (Shikoku, Honshu: Tokyo), Korea.

3. *Pheretima edoensis* sp. nov.

[Japanese name: Edo-mimizu]

(Figs. 2–8)

Materials examined. Holotype (NSMT-An 337) and 2 paratypes (NSMT-An 338): From soil under a mixed forest of evergreen and deciduous trees, the Imperial Palace, Tokyo, St. 21, 22–VII–1996, coll. by M. Imajima and K. Ishizuka. Other specimens examined: 15 exs. collected with the type series; 4 exs. St. 21, 20–VIII–1996; 25 exs. St. 21, 18–IX–1997, the Imperial Palace, Tokyo.

Description. *Holotype:* Length of body 78 mm, width 3.1 mm, with 102 segments. *Paratypes:* Length of body 50–80 mm, width 2.6–3.4 mm, with 95–110 segments. Pinkish brown dorsally, light whitish brown ventrally.

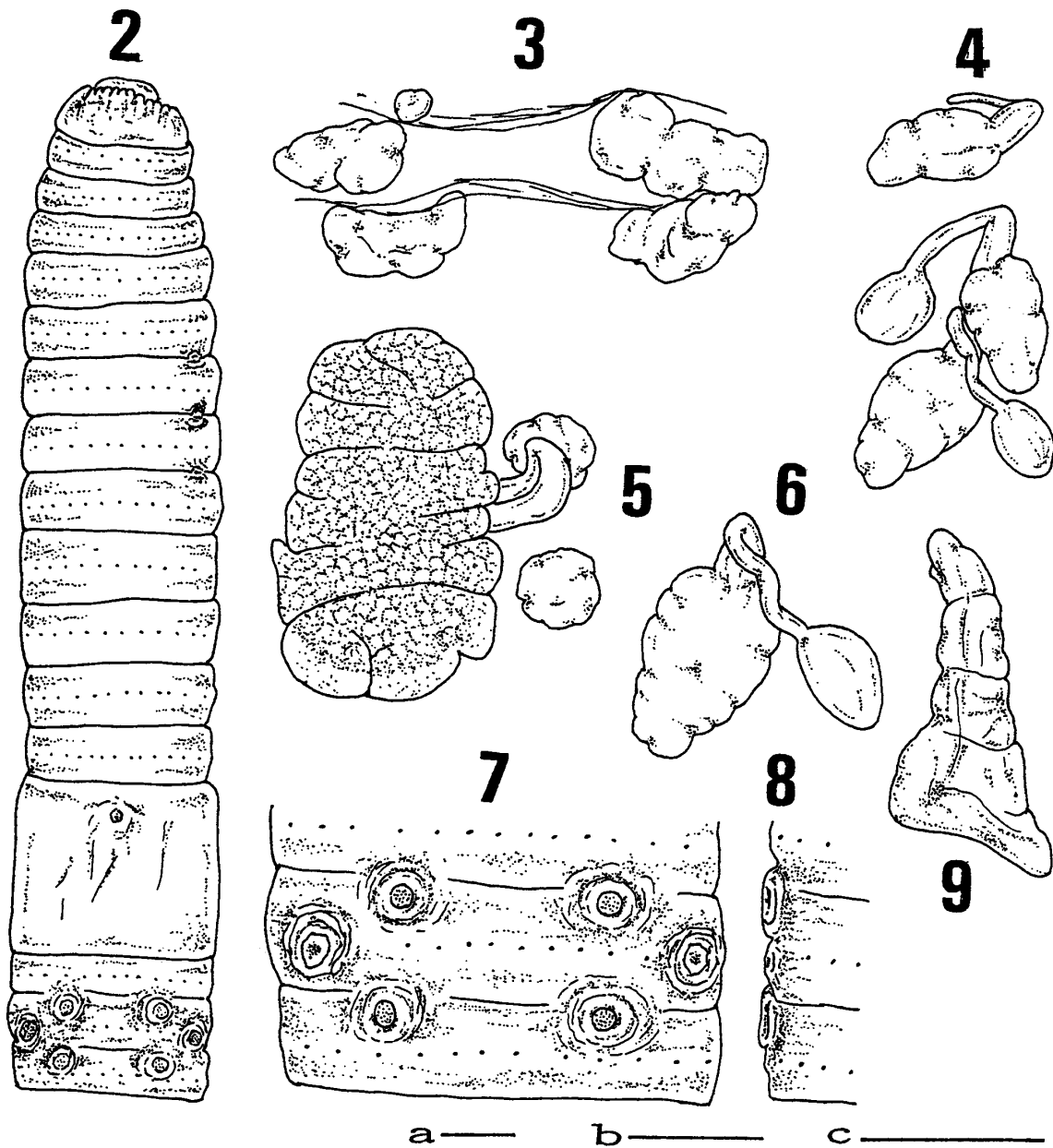
External characters: Three pairs of spermathecal pore situated in furrows 6/7/8/9, in ventro-lateral sides, separated by a distance of ca. 1/3 body circumference. Genital markings paired, large circular to oval sucker-shape; postclitellar median to line of male pores, presetal on segments XVIII–XIX (Figs. 7, 8). Male pores simple, on medium-sized porophores, superficial on segment XVIII (Figs. 7, 8), separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12. Setal number 30–36 in segment VII, 36–42 in segment XX.

Internal characters: Simple intestinal caeca, paired, originating in segment XVII (Fig. 9), extending anteriorly for 4–5 segments. Intestine beginning from segment XIV. Genital gland paired, glandular masses, in segments XVIII–XIX (Fig. 5). Septa absent in furrows 8/9/10, slightly thickened in 5/6/7/8, slightly thickened and muscular in 10/11/12/13/14. Three pairs of spermathecae in segments VI–IX (Figs. 4, 6); ampulla consisting of shovel-shaped pouch and short thick duct; diverticulum consisting of circular to oval pouch and long narrow duct. Seminal vesicles extending to dorsal line on segments XI–XII (Fig. 3). Prostata extending to segments XVII–XX (Fig. 5), associated with male pores.

Etymology. The specific name refers to the old place name of Tokyo.

Remarks. *Pheretima edoensis* resembles *P. micronaria* (Goto & Hatai, 1898), in the features of the intestinal caeca and genital markings. However, it is distinguishable from the latter in that: (1) the spermathecal pores number four pairs (vs. three pairs) and (2) the diverticulum is present (vs. lacking).

Distribution. Known only from the type locality.



Figs. 2-9. *Pheretima edoensis* sp. nov. Holotype, NSMT-AN-337. 2. Anterior body, ventral view. 3. Testes and seminal vesicles, dorsal view. 4, 6. Spermathecae. 5. Prostate gland with a duct and genital glands (glandular masses). 7. Male pores and genital markings on segments XVII-XIX. 8. Segments XVII-XIX, lateral view. 9. Intestinal caecum. (Scale bars—a: 1 mm for 2, b: 1 mm for 3-6, 9, c: 1 mm for 7, 8)

4. *Pheretima heteropoda* (Goto & Hatai, 1898)
[Japanese name: Henisei-mimizu]

Perichaeta heteropoda Goto & Hatai, 1898, p. 69.

Pheretima heteropoda: Michaelsen, 1900, p. 315 ; Ohfuchi, 1937, p. 42, figs. 4-7.

Materials examined. Sts. 2(2), 3(8), 4(8), 6(2), 10(1), 11(5), 12(1), 13(2), 14(10), 15(33), 16(6), 17(2), 18(3), 19(7).

External characters. Length of body 90–230 mm, width 3.5–6.0 mm, with 95–150 segments. Dull greenish brown grey dorsally. Four pairs of spermathecal pores situated in furrows 5/6/7/8/9. Genital markings paired, circular sucker-shaped; preclitellar slightly median to line of spermathecal pores, presetal on segments VII–IX, variable in number and situation. Male pores simple, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12. Clitellum including segments XIV–XVI.

Internal characters. Simple intestinal caeca paired, originating on segment XXVII. Genital glands paired, glandular masses, on segments VII–IX. Four pairs of spermathecae on segments VI–IX; ampulla consisting of shovel-shaped sac and duct; diverticulum consisting of globular shaped pouch and duct.

Distribution. Japan (Kyushu, Shikoku, Honshu), Korea.

5. *Pheretima hupeiensis* (Michaelsen, 1895)

[Japanese name: Kuso-mimizu]

Perichaeta hupeiensis Michaelsen, 1895, p. 35, figs. 11, 12.

Pheretima hupeiensis: Michaelsen, 1900, p. 273; Chen, 1931, p. 122; Chen, 1933, p. 251, fig. 19.

Amyntas hupeiensis: Beddard, 1900, p. 646; Easton, 1981, p. 53.

Materials examined. St. 16(4).

External characters. Length of body 70–120 mm, width 3.0–3.4 mm, with 110–140 segments. Greenish brown dorsally. Three pairs of spermathecal pore, situated in furrows 6/7/8/9. Genital markings paired, large circular to oval sucker-shape; postclitellar to line of male pores, pre- and postsetal on segments XVII and XIX. Male pores simple, on medium-sized porophores, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12.

Internal characters. Simple intestinal caeca paired, originating in segment XVII. Genital glands paired, glandular masses, on segments XVII and XIX. Three pairs of spermathecae on segments VII–IX; ampulla consisting of convoluted tube pouch and duct; diverticulum consisting of long convoluted tube and duct.

Distribution. Japan (Okinawa, Kyushu, Shikoku, Honshu, Hokkaido), China, Korea.

6. *Pheretima irregularis* (Goto & Hatai, 1898)

[Japanese name: Fukisoku-mimizu]

Perichaeta irregularis Goto & Hatai, 1899, p. 13.

Pheretima irregularis: Ohfuchi, 1938a, p. 1, figs. 1–16; Ohfuchi, 1939, p. 81, figs. 1–4; Kobayashi, 1938, p. 110; Yamaguchi, 1962b, p. 17.

Materials examined. Sts. 3(1), 4(6), 5(3), 6(2), 11(1), 12(2), 15(1), 16(1), 20(1).

External characters. Length of body 60–150 mm, width 5.0–7.0 mm, with 90–110 segments. Brown dorsally. Two pairs of spermathecal pores situated in furrows 6/7/8. Genital markings paired, small papillae shape, presetal on segments VI–VIII, closely associated with spermathecal pores, postsetal on segments VI–VII, slightly median to line of spermathecal pores and occasionally lacking; postclitellar in setal line on segment XVIII. Male pores simple, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI.

Internal characters. Maniccate intestinal caeca each with 4–6 diverticula, originating in segment

XXVII. Genital glands consisting of capsulogenous glands. Two pairs of spermathecae on segments VII–VIII; ampulla consisting of shovel-shaped pouch and duct; diverticulum consisting of guinea pepper-shape pouch and duct.

Distribution. Japan (Kyushu, Shikoku, Honshu, Hokkaido).

7. *Pheretima masatacae* (Beddard, 1892)

[Japanese name: Futatsuboshi-mimizu]

Perichaeta masatacae Beddard, 1892, p. 761.

Pheretima masatacae: Michaelsen, 1900, p. 282; Ohfuchi, 1938b, p. 62, figs. 6, 7.

Amyntas masatacae: Beddard, 1900, p. 632.

Materials examined. St. 16 (9).

External characters. Length of body 190–260 mm, width 5.5–6.8 mm, with 110–120 segments. Brown dorsally. Two pairs of spermathecal pores situated in furrows 7/8/9. Genital markings paired, circular sucker-shape; preclitellar closely associated with spermathecal pores, postsetal on segments VII–IX; postclitellar closely associated with male pores, presetal on segment XVIII. Male pores simple, on medium-sized porophores, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI.

Internal characters. Serrate intestinal caeca, paired, originating in segment XXVII. Genital glands consisting of capsulogenous glands. Two pairs of spermathecae on segments VIII–IX. Ampulla consisting of shovel-shaped pouch and short duct; diverticulum consisting of convoluted tube and duct.

Distribution. Japan (Okinawa, Kyushu, Shikoku, Honshu: Kinki, Chubu and Kanto Districts), China, Korea.

8. *Pheretima megascolidioides* (Goto & Hatai, 1899)

[Japanese name: Norakura-mimizu]

Perichaeta megascolidioides Goto & Hatai, 1899, p. 21, fig. 16.

Pheretima megascolidioides: Michaelsen, 1900, p. 283; Ohfuchi, 1938c, p. 178; Song & Paik, 1971, p. 193, figs. 1–8.

Amyntas megascolidioides: Beddard, 1900, p. 622.; Easton, 1981, p. 54.

Materials examined. Sts. 6(7), 16 (2).

External characters. Length of body 150–250 mm, width 8.0–9.0 mm, with 115–130 segments. Brown dorsally. Five pairs of spermathecal pore, situated in furrows 4/5/6/7/8/9. Genital markings paired, circular sucker-shape; postclitellar in line with male pores, postsetal on segments XVII–XX. Male pores simple, superficial on segment XIX. Female pore single, midventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI.

Internal characters. Multiple intestinal caeca paired, originating in segment XXVII. Genital glands large, paired, glandular masses. Five pairs of spermathecae on segments V–IX; ampulla consisting of shovel-shaped sac and thick duct; diverticulum consisting of duct and convoluted tube.

Distribution. Japan (Kyushu, Shikoku, Honshu), Korea.

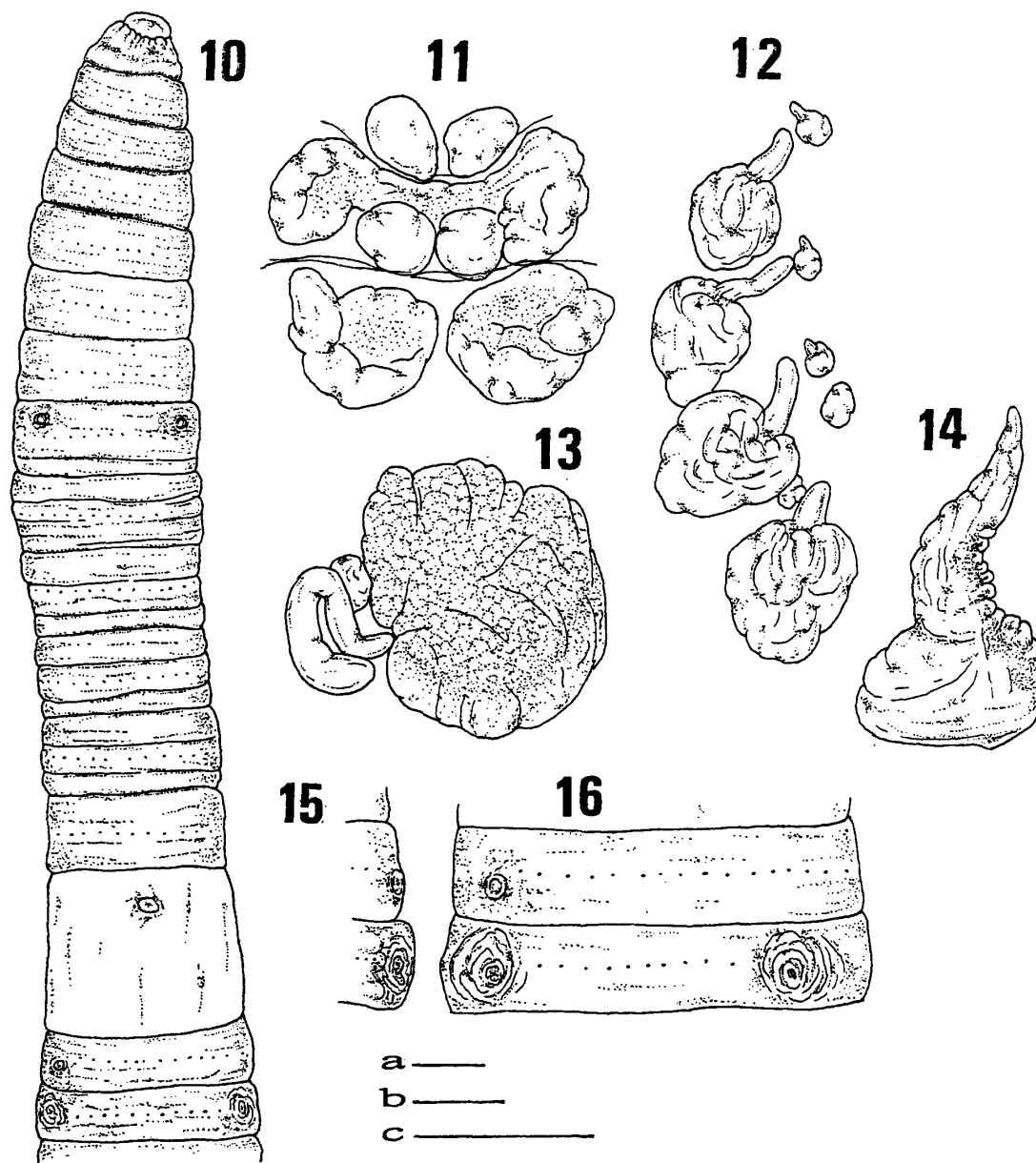
9. *Pheretima nigella* sp. nov.

[Japanese name: Kuroboku-mimizu]

(Figs. 10–16)

Materials examined. Holotype (NSMT-An 339): From soil under a grassy place of evergreen and deciduous trees, the Imperial Palace, Tokyo, St. 22, 22–VII–1996, coll. by K. Ishizuka.

Description. Holotype: Length of body 137 mm, width 6.4mm, with 136 segments. Dark brown dorsally, yellowish gray ventrally.



Figs. 10–16. *Pheretima nigella* sp. nov. Holotype, NSMT-AN-339. 10. Anterior body, ventral view. 11. Testes and seminal vesicles, dorsal view. 12. Spermathecae and genital glands (glandular masses). 13. Prostate gland with a duct and genital glands (glandular masses). 14. Intestinal caecum. 15. Segments XVI–XVIII, lateral view. 16. Male pores and genital markings on segments XVII–XVIII. (Scale bars—a: 1 mm for 10, b: 1 mm for 11–14, c: 1 mm for 15,16)

External characters: Four pairs of spermathecal pores situated in furrows 5/6/7/8/9 in ventro-lateral sides, separated by a distance of ca. 1/3 body circumference. Genital markings (Fig. 10) paired, circular sucker-shaped; preclitellar slightly median to line of spermathecal pores, presetal on segment VIII, closely associated with spermathecal pores, postsetal on segments VI–VIII; postclitellar in line with male pores, postsetal on segment XVII (Figs. 15, 16). Male pores simple, superficial on segment XVIII (Figs. 15, 16), separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginnings in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 34 in segment VII, 43 in segment XX.

Internal characters: Serrate intestinal caeca, paired, originating in segment XXVII (Fig. 14), extending anteriorly for 4 segments. Intestine beginning from segment XV. Genital glands paired, glandular masses (ducts present), on segments VI–IX and XVIII (Fig. 12). Septa absent in furrows 8/9/10, very thickened and muscular in furrows 5/6/7/8 and 10/11/12/13/14. Four pairs of spermathecae on segments VI–IX (Fig. 12); ampulla consisting of shovel-shaped sac and duct; diverticulum absent. Seminal vesicles, extending on segments XI–XII (Fig. 11). Prostata, extending in segments XVII–XIX (Fig. 13), ducts corresponding to male pores.

Etymology. The specific name is derived from the Latin *nigellus* meaning blackish which refers to the dark brown dorsum.

Remarks. *Pheretima nigella* resembles *P. divergens* (Michaelsen, 1892), in the features of the intestinal caeca and genital markings. However, *P. nigella* is distinguishable from the latter in that: (1) the diverticulum is absent (vs. present) and (2) the genital markings are present at the presetal on segment VIII (vs. on segments V–VIII).

Distribution. Known only from the type locality.

10. *Pheretima octo* Ishizuka, 2000

[Japanese name: Hachinoji-mimizu]

Pheretima octo Ishizuka, 2000, pp. 31–32, figs. 81–89.

Materials examined. Sts. 4(2), 6(4), 11(6), 12(4), 13(1), 15(4), 16(3), 18(2), 19(2), 20(3), 21(7).

External characters. Length of body 70–100 mm, width 3.0–4.0 mm, with 80–110 segments. Brown dorsally. Four pairs of spermathecal pore situated in furrows 5/6/7/8/9. Genital markings paired, circular sucker-shape; postclitellar presetal on segment XVII, in contact with the male pores in 8-shape. Male pores on sucker-shape porophores, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13.

Internal characters. Simple intestinal caeca paired, originating in segment XVII. Genital glands paired, glandular masses, on segment XVIII. Four pairs of spermathecae in segments VI–IX; ampulla consisting of shovel-shaped pouch and short, stout duct; diverticulum absent.

Distribution. Japan (Tokyo).

11. *Pheretima parvula* sp. nov.

[Japanese name: Chicchi-mimizu]

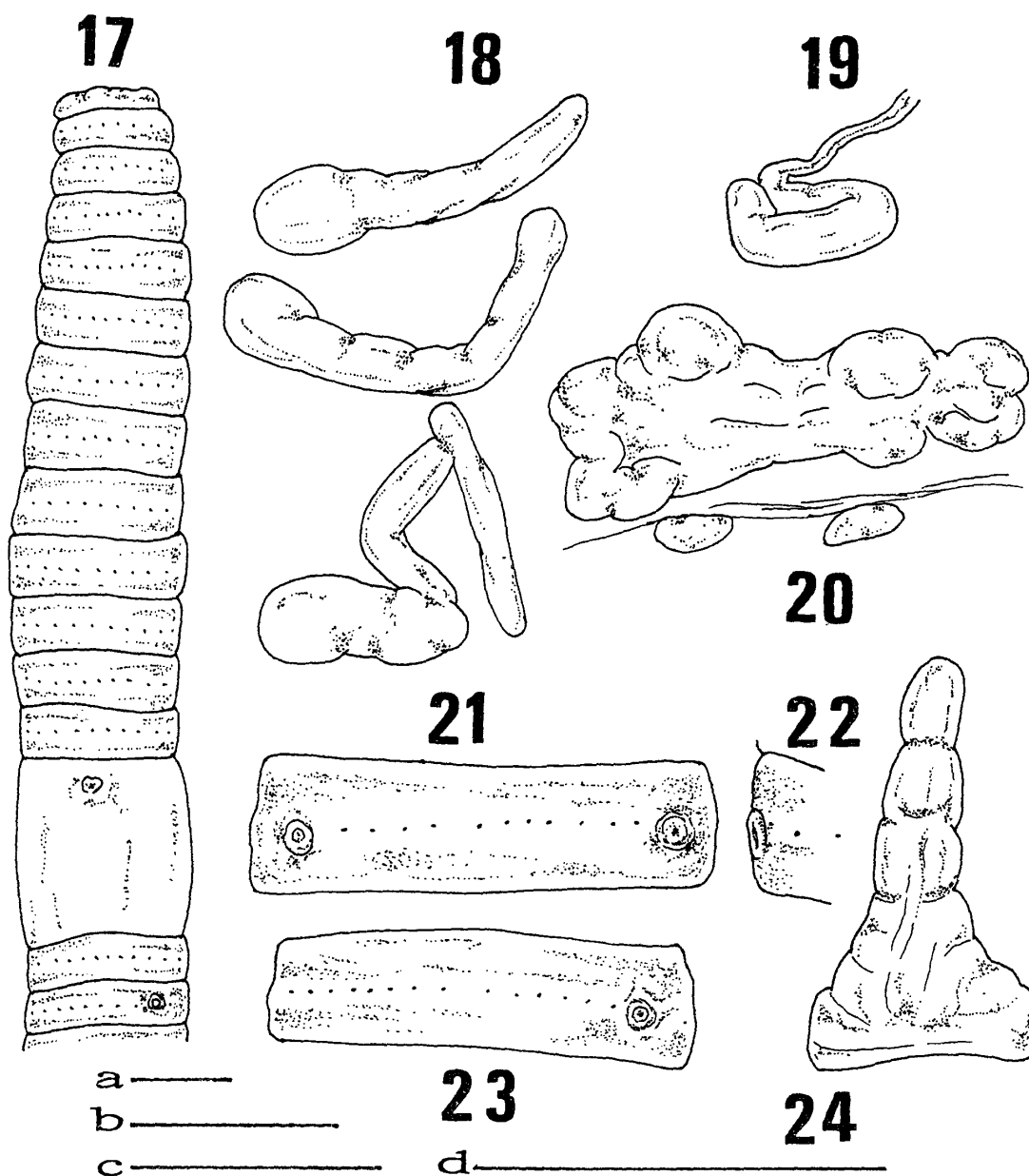
(Figs. 17–24)

Materials examined. Holotype (NSMT-An 340) and 2 paratypes (NSMT-An 341): From soil under a mixed forest of evergreen and deciduous trees, The Imperial Palace, Tokyo, St. 16, 22–VII–1996, coll.

by M. Imajima and K. Ishizuka. Other specimens examined: 14 exs. collected with the type series; 7 exs. St. 16, 23–VII–1996; 23 exs. Sts. 11, 16, 20–VIII–1996; 21 exs. St. 16, 23–VII–1997, the Imperial Palace, Tokyo.

Description. Holotype: Length of body 46 mm, width 2.2 mm, with 96 segments. Paratypes: Length of body 45–62 mm, width 2.2–2.5 mm, with 95–98 segments. Brown dorsally, light brown ventrally.

External characters: Two pairs of spermathecal pores situated in furrows 6/7/8 in ventro-lateral sides, and occasionally absent, variable in number, separated by a distance of ca. 1/3 body circumference.



Figs. 17–24. *Pheretima parvula* sp. nov. Holotype, NSMT-AN-340 (17–23). Paratype, NSMT-AN-341 (24). 17. Anterior body, ventral view. 18. Spermathecae. 19. Prostate duct. 20. Seminal vesicles and ovary, dorsal view. 21–23. Male pores on segment XVIII. 22. Segment XVIII, lateral view. 24. Intestinal caecum. (Scale bars—*a*: 1 mm for 18, *b*: 1 mm for 19, 20, 23, *c*: 1 mm for 21, 22, 24, *d*: 1 mm for 17)

Genital markings absent (Fig. 17). Male pores small, simple, on medium-sized porophores, superficial on segment XVIII (Figs. 21,22,23), and occasionally in one side separated by a distance of ca. 1/3 body circumference or absent. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 50–58 in segment VII, 60–66 in segment XX.

Internal characters. Simple intestinal caeca paired, originating in segment XXVII (Fig. 24), extending anteriorly for 4–5 segments. Intestine beginning from segment XIV. Genital glands absent. Septa absent in furrows 8/9/10, slightly delicate in furrows 5/6/7/8 and 10/11/12/13/14. Two pairs of spermathecae in segments VII–VIII (Fig. 18), ampulla consisting of circular to oval pouch and duct, but duct occasionally absent; diverticulum absent. Seminal vesicles very small, extending to dorsal line on segments XI–XII (Fig. 20). Prostata duct on segment XVIII (Fig. 19), corresponding to male pore, and occasionally absent.

Etymology. The specific name is derived from Latin and means the small size of the body.

Remarks. *Pheretima parvula* resembles *P. oyensis* Ohfuchi, 1937, in the features of the intestinal caeca and genital markings. However, it is distinguishable from the latter in having two pairs of spermathecal pores (vs. three pairs).

Distribution. Known only from the type locality.

12. *Pheretima schmardae* (Horst, 1883)

[Japanese name: Kikuchi-mimizu]

Megascolex schmardae Horst, 1883, p. 194.

Perichaeta schmardae: Michaelsen, 1892, p. 235.

Pheretima schmardae: Michaelsen, 1900, p. 302; Chen, 1931, p. 125, figs. 3, 4.

Amyntas schmardae: Beddard, 1900, p. 619.

Metaphire schmardae: Easton, 1981, p. 53.

Materials examined. Sts. 2(1), 3(1), 4(15), 5(5), 7(1), 10(3), 11(1).

External characters. Length of body 40–110 mm, width 3.0–5.0 mm, with 50–100 segments. Reddish brown dorsally with light greenish grey setae line, therefore, dorsal surface showing a banded appearance and often give off gloss light. Two pairs of spermathecal pores situated in furrows 7/8/9. Genital markings absent. Male pores simple, superficial on segment XVIII, within copulatory pouches. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI.

Internal characters. Manicate intestinal caeca each with 4–6 diverticula, originating in segment XXVII. Genital glands absent. Two pairs of spermathecae in segments VIII–IX; ampulla consisting of shovel-shaped pouch and duct; diverticulum consisting of convoluted tube and duct.

Distribution. Japan (Okinawa, Kyushu, Shikoku, Honshu: Kinki, Chubu and Kanto Districts), China, Taiwan.

13. *Pheretima setosa* sp. nov.

[Japanese name: Sakurafuto-mimizu]

(Figs. 25–33, Table 1)

Materials examined. Holotype (NSMT-An 342) and 3 paratypes (NSMT-An 343): From soil under

a grassy place of deciduous trees, the Imperial Palace, Tokyo, St. 20, 17–IX–1997, coll. by M. Imajima and K. Ishizuka. Other specimens examined: 7 exs. collected with type series; 22 exs. from St. 20, 22–X–1997, the Imperial Palace, Tokyo.

Description. Holotype: Length of body 159 mm, width 4.6 mm, with 138 segments. Paratypes: Length of body 145–170 mm, width 4.2–5.7 mm, with 110–140 segments. Dark brown dorsally, light yellowish grey ventrally.

External characters: Four pairs of spermathecal pores present in furrows 5/6/7/8/9 in ventro-lateral sides, separated by a distance of ca. 1/3 body circumference. Genital markings paired, circular sucker-shape; preclitellar closely associated with spermathecal pores, postsetal on segments V–VIII (Figs. 25, 26), slightly median to line of spermathecal pores, postsetal on segments VII–VIII or occasionally absent, variable in number and situation; postclitellar closely associated with male pores, presetal on segment XVIII (Figs. 29, 32, 33), and variable in number and situation (Table 1). Male pores simple, on medium-sized porophores, superficial on segment XVIII (Figs. 29, 32, 33), separated by a distance of ca. 1/3 body circumference. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI. Setal number 33–40 in segment VII, 40–56 in segment XX.

Internal characters: Serrate intestinal caeca, paired, originating in segment XXVII (Fig. 30), extending anteriorly to segments 4–5. Intestine beginning from segment XIV. Genital glands paired, glandular masses, on segments V–VIII and XVIII (Fig. 28). Septa absent in furrows 8/9/10, and thickened in furrows 5/6/7/8 and 10/11/12/13/14. Four pairs of spermathecae on segments V–IX (Fig. 28). Ampulla consisting of shovel-shaped pouch and short duct (Fig. 28). Diverticulum absent. Seminal vesicles small, extending to dorsal line on segments XI–XII (Fig. 27). Prostata on segment XVIII (Fig. 31), corresponding to male pores.

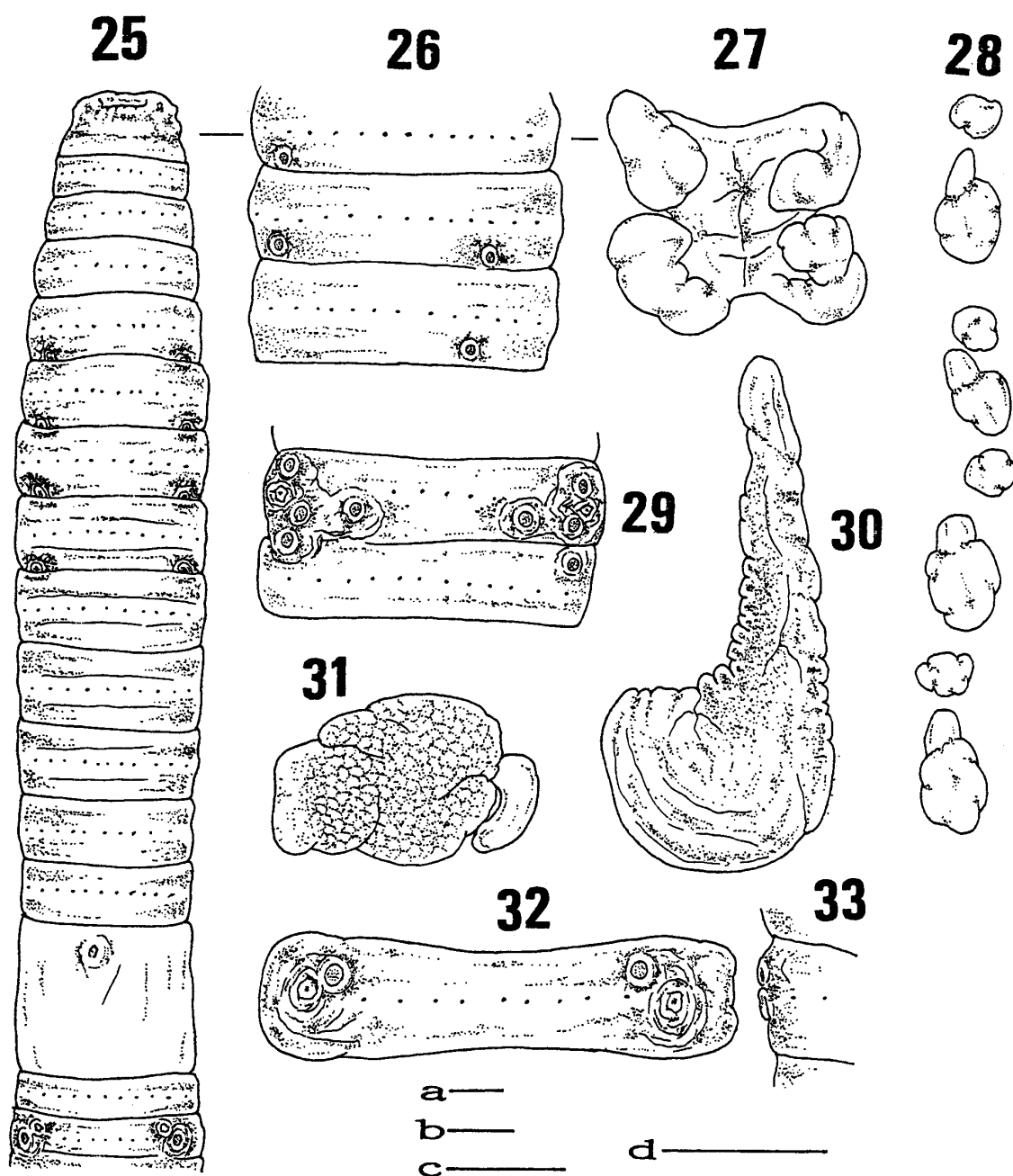
Etymology. The specific name is derived from the Latin *setosus* meaning bristly which refers to the many setae present on segments.

Remarks: *Pheretima setosa* resembles *P. divergens* (Michaelsen, 1892), in the features of the intestinal caeca and genital markings. However, *P. setosa* is distinguishable from the latter in that: (1) the diverticulum is absent (vs. having) and (2) the genital markings are present at the postsetal on segments

Table 1. The number, arrangement and position of genital papillae in 19 individuals of *P. setosa* sp. nov.

Position No	Preclitellar					Postclitellar	
	V	VI	VII	VIII	IX	XVIII	XIX
5	1 pair	1 pair	1 pair	1 pair	0	0	0
4	1 pair	1 pair	1 pair	1 pair	0	1 pair	0
3	1 pair	1 pair	1 pair	1 pair	0	one side	0
1	1 pair	1 pair	1 pair	1 pair	0	5 and 4 ¹⁾	0
1	1 pair	1 pair	1 pair	1 pair	0	3 and 3	0
1	1 pair	1 pair	2 pairs	2 pairs	1 pair	2 and 5	0
1	1 pair	1 pair	2 pairs	2 pairs	1 pair	3 and 3	1 pair
1	1 pair	1 pair	2 pairs	2 pairs	1 pair	4 and 5	4 and 1
1	1 pair	1 pair	1 and 2	2 pairs	one side	2 and 3	one side
1	1 pair	1 pair	1 and 2	2 pairs	one side	6 and 4	2 and 0

¹⁾ Five on one side and four on the other side.



Figs. 25–33. *Pheretima setosa* sp. nov. Holotype, NSMT-AN-342 (25, 27, 28, 30–33). Paratype, NSMT-AN-343 (26, 29). 25. Anterior body, ventral view. 26. Segments VI–VIII, ventral view. 27. Seminal vesicles, dorsal view. 28. Spermathecae and genital glands (glandular masses). 29. Male pores and genital markings on segments XVIII–XIX. 30. Intestinal caecum. 31. Prostate gland with a duct. 32. Male pores and genital markings on segment XVIII. 33. Segment XVIII, lateral view. (Scale bars—*a*: 1 mm for 25, *b*: 1 mm for 26, *c*: 1 mm for 27, 29, 31, *d*: 1 mm for 28, 30, 32, 33).

V–VIII (vs. presetal on the same segments).

Distribution. Known only from the type locality.

14. *Pheretima tamaensis* Ishizuka, 1999

[Japanese name: Tama-mimizu]

Pheretima tamaensis Ishizuka, 1999b, pp. 231–233, figs. 8–17.

Materials examined. Sts. 1(3), 3(2), 4(4), 5(5), 7(9), 8(5), 9(3), 10(18), 12(3), 15(11), 16(17), 19(27).

External characters. Length of body 60–90 mm, width 2.5–3.5 mm, with segments 60–105. Light purplish brown dorsally, giving out luster of violet light. Two pairs of spermathecal pores situated in furrows 6/7/8. Genital markings paired, very large circular to oval sucker-shape; postclitellar median to line of male pores, postsetal on segments XVII–XVIII (extending to intersegmental at 17/18–18/19), variable in number and situation. Male pores simple, on medium-sized porophores, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12.

Internal characters. Simple intestinal caeca paired, originating in segment XVII. Genital glands large paired, glandular masses, on segments XVII–XVIII. Two pairs of spermathecae in segments VII–VIII; ampulla being long pouch with stout, short duct; diverticulum absent.

Distribution. Japan (Tokyo).

15. *Pheretima vittata* (Goto & Hatai, 1898)

[Japanese name: Futosuji-mimizu]

Perichaeta vittata Goto & Hatai, 1898, p. 74.

Pheretima vittata: Michaelsen, 1900, p. 312; Hatai, 1929, p. 271, figs. 1, 2; Yamaguchi, 1962a, p. 28, fig. 13.

Amyntas vittatus: Beddard, 1900, p. 635.

Materials examined. Sts. 14(7), 15(6).

External characters. Length of body 90–180 mm, width 5.0–7.0 mm, with 90–110 segments. Brown dorsally with reddish brown intersegmental furrow (dorsal surface showing a banded appearance). Two pairs of spermathecal pores situated in furrows 6/7/8. Genital markings paired, small papillae shape presetal on segments VII, closely associated with spermathecal pores, postsetal on segments VI–VII, and occasionally; postclitellar on setal line on segment XVIII. Male pores simple, superficial on segment XVIII, but rarely found. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 12/13. Clitellum including segments XIV–XVI.

Internal characters. Maniccate intestinal caeca each with 6–8 diverticula, originating in segment XXVII. Genital glands consisting of capsulogenous glands. Two pairs of spermathecae in segments VII–VIII; ampulla consisting of shovel-shaped pouch and duct; diverticulum consisting of duct and distal sausage-like swelling.

Distribution. Japan (Kyushu, Shikoku, Honshu, Hokkaido).

16. *Pheretima* sp. A

Materials examined. St. 12 (2).

External characters. Length of body 96 mm, width 3.5 mm, with 97 segments. Light brown dorsally, light whitish brown ventrally. Four pairs of spermathecal pores situated in furrows 5/6/7/8/9. Genital markings paired, circular to oval sucker-shape; preclitellar slightly median to line of spermathecal pores,

presetal on segments VII–IX, closely associated with spermathecal pores, postsetal on segments VI–VIII, and occasionally in one side; postclitellar median to line of male pores, presetal on segments XVIII–XIX.

Male pores simple, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12. Clitellum including segments XIV–XVI.

Internal characters. Simple intestinal caeca paired, originating in segment XXVII, extending anteriorly for 4 segments. Genital glands, glandular masses. Septa absent in furrows 8/9/10, slightly thickened in 5/6/7/8 and thickened in 10/11/12/13/14. Four pairs of spermathecae in segments VI–IX; ampulla consisting of long shovel-shaped pouch and short duct; diverticulum absent. Seminal vesicles small, extending to dorsal line on segments XI–XII. Prostata large, extending to segments XVIII–XIX, corresponding to male pore.

Remarks. *Pheretima* sp. A resembles *P. micronaria* (Goto & Hatai, 1898), but is distinguishable from the latter in that : (1) the preclitellar and genital markings are present (vs. lacking) and (2) the body is light brown dorsally (vs. light pinkish brown). Precise identification requires examination of more specimens.

17. *Pheretima* sp. B

Materials examined. Sts. 6(7), 16(10), 20(14), 21(8).

External characters. Length of body 80–170 mm, width 3.0–4.5 mm, with 95–150 segments. Dull greenish brown grey dorsally. Four pairs of spermathecal pores situated in furrows 5/6/7/8/9. Genital markings paired, circular sucker-shape; preclitellar slightly median to line of spermathecal pores, presetal on segments VII–IX, variable in number and situation. Male pores simple, superficial on segment XVIII. Female pore single, mid-ventrally on segment XIV. First dorsal pore beginning in furrow 11/12. Clitellum including segments XIV–XVI.

Internal characters. Simple intestinal caeca paired, originating in segment XXVII. Genital glands paired, glandular masses, on segments VII–IX. Four pairs of spermathecae on segments VI–IX; ampulla consisting of shovel-shaped sac and duct; diverticulum consisting of rubber balloon-shaped pouch and duct.

Remarks. *Pheretima* sp. B resembles *P. heteropoda* (Goto & Hatai, 1898), but is distinguishable from the latter by diverticulum consisting of rubber balloon-shaped pouch (oval pouch in *P. heteropoda*) and duct.

Pheretima sp. B may be related to *P. nipponica*, *P. difrigence*, *P. divergens* and *P. marenzelleri*. However, those four species have been confused in the literature. Conclusive identification has been reserved.

Family Lumbricidae Rafinesque-Schmaltz, 1815

Genus *Allolobophora* Eisen, 1873

18. *Allolobophora japonica* Michaelsen, 1892

[Japanese name: Sakura-mimizu]

Allolobophora japonica Michaelsen, 1892, p. 230.

Helodrilus (Allolobophora) japonicus: Michaelsen, 1900, p. 481.

Allolobophora japonica: Oishi, 1934, pp. 133–134.

Eisenia japonica: Easton, 1981, pp. 43–44.

Materials examined. Sts. 2(3), 3(7), 16(4).

External characters. Length of body 40–90 mm. Body cylindrical, whitish grey or dark reddish

brown. Prostomium epilobic. Clitellum on segments XXIII–XXXI. Tubercula pubertatis in form of paired longitudinal ridges on segments XXVII–XXIX, often disrupted and on segments XXVII–XXIX. Male pores on segment XV. Spermathecal pores in furrows 9/10/11, in setal line c. First dorsal pore in furrow 4/5. Setae closely paired, setal ratio $93aa=10ab=46bc=7cd=310dd$.

Distribution. Japan (Kyushu, Shikoku, Honshu, Hokkaido).

Genus *Eisenia* Malm, 1877

19. *Eisenia foetida* (Savigny, 1826)

[Japanese name: Shima-mimizu]

Enterion foetidum Savigny, 1826, p. 182.

Eisenia foetida: Michaelsen, 1900, P. 475 ; Easton, 1981, pp. 42–43.

Materials examined. St. 16 (8).

External characters. Length of body 40–90 mm. Body cylindrical, reddish purple or brown dorsally, yellow in intersegmental furrows and ventrally. Prostomium epilobic. Clitellum on segments XXIV–XXXII. Tubercula pubertatis in form of paired longitudinal ridges on segments XXVIII–XXXI. Male pores on segment XV. Spermathecal pore in furrows 9/10/11, near dorsal line. First dorsal pore in furrow 5/6. Setae closely paired, $4aa=ab=4bc=cd=16dd$.

Distribution. Japan (Kyushu, Shikoku, Honshu, Hokkaido), cosmopolitan.

Family Moniligastridae Beddard, 1886

Genus *Drawida* Michaelsen, 1900

20. *Drawida* sp.

Materials examined. St. 16 (6).

External characters. Length of body 50–70 mm. Setae lumbricine. Dorsal pores absent. Clitellum including segments X–XIII. Male pores (penis) in or near intersegmental furrow 10/11. Genital markings, very large circular sucker-shape, on segments VII–XII, variable in number and situation, and occasionally lacking.

Internal characters. Prostates absent. Two or three oesophageal gizzards present in segments XII–XIV, calciferous glands and intestinal caeca absent. One pair of spermathecae on intersegmental 7/8; ampulla consisting of oval-shaped sac and closely or compactly coiled duct.

These specimens are too juvenile for specific identification.

Distribution. Japan (Tokyo).

Results

A total of 583 specimens of oligochaetes have been collected from 22 stations in the Imperial Palace. They are classified into 20 species of four genera in three families (Megascolecidae, Lumbricidae and Moniligastridae), of which the genus *Pheretima* with 17 species is best represented. The materials include four new species of *Pheretima*, and three unidentified species. Of the four new species, the occurrence of *Pheretima edoensis*, *P. nigella* and *P. setosa* were restricted to only at single stations (Table 2). One or more species usually occurred at each station, with the maximum of 13 species, including *Eisenia foetida* and *Drawida* sp. collected together at St. 16 near the Biological Laboratory, Imperial Household. None of the oligochaeta species is ubiquitous, eight species being limited to single stations. On the other hand, *Pheretima tamaensis* and *P. heteropoda* are widely distributed in this area: a total of 107 specimens of the

Table 2. Reported species and number of individuals collected at stations in the Imperial Palace.

Species	Station																						Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
<i>Pheretima agrestis</i> (Goto & Hatai)				12										1	4								17
<i>P. aokii</i> Ishizuka			3	11	2		1			1	1	1	7			3	6						35
<i>P. edoensis</i> sp. nov.																							47
<i>P. heteropoda</i> (Goto & Hatai)			2	8	8	2				1	5	1	2	10	33	6	2	3	7				90
<i>P. hupeiensis</i> (Michaelsen)																4							4
<i>P. irregularis</i> (Goto & Hatai)			1	6	3	2					1	2			1	1				1			18
<i>P. masatacae</i> (Beddard)																							9
<i>P. megascolidioides</i> (Goto & Hatai)						7										9							9
<i>P. nigella</i> sp. nov.																2							1
<i>P. octo</i> Ishizuka				2		4					6	4	1		4	3		2	2	3	7		38
<i>P. parvula</i> sp. nov.											24					42							66
<i>P. schmardae</i> (Horst)		1	1	15	5		1			3	1												27
<i>P. setosa</i> sp. nov.																							33
<i>P. tamaensis</i> Ishizuka																				33			107
<i>P. vittata</i> (Goto & Hatai)	3		2	4	5		9	5	3	18		3			11	17		27					13
<i>P. sp. A</i>														7	6								2
<i>P. sp. B</i>												2											39
<i>Allolobophora japonica</i> Michaelsen						7										10			14	8			14
<i>Eisenia foetida</i> (Savigny)			3	7												4							8
<i>Drawida</i> sp.																8							6
Total (species)	1	3	6	7	4	5	3	1	1	4	6	6	2	3	7	13	1	2	3	4	3	1	20
Total (specimens)	3	6	22	58	15	22	11	5	3	23	38	19	3	18	62	118	2	5	36	51	62	1	583

former were collected from 12 stations and 90 specimens of the latter from 14 stations.

要 約

皇居内の動植物相総合調査が1996–1999年度にわたって実施されたのに伴い、著者らは陸生貧毛類の調査を担当した。皇居内のいろいろな植生の22地点で合計583個体の貧毛類を採集し、分類学的研究を行った結果、フトミミズ科17種、ツリミミズ科2種とジュズイミミズ科1種の4属20種を確認した。このうち、フトミミズ科の4種は新種として記載された。フトミミズ科の2種とジュズイミミズ科の1種は未同定種である。4新種のうち、*Pheretima setosa* はSt.20のみから33個体、*P. edoensis* はSt.21のみから47個体、*P. nigella* はSt.22から1個体、そして*P. parvula* はSt.11から24個体とSt.16から42個体が得られた。前の3種は共に1個所のみから出現している。

最も多くの種が採集された場所は生物学御研究所近くのSt.16で13種が見出され、シマミミズとジュズイミミズの一つもこの場所から採集された。ジュズイミミズ科の種は関東地方からは東京都世田谷区で1例の報告しかない稀な種であるが、このたび皇居で採集された。次いでSts.4, 15からそれぞれ7種、Sts.3, 11, 12からそれぞれ6種見出され、ただ1種のみ見出された場所はSts.1, 8, 9, 17, 22であった。また、*P. heteropoda* は14地点、*P. tamaensis* は12地点、*P. octo* は11地点から出現している。

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